WASHINGTON
SCIENCE TRENDS

HIGHLIGHTS

- GROUND EFFECT MACHINES
- PROJECT RAM
- CBR WARFARE
- METALS/MATERIALS RESEARCH
- PUBLICATION CHECKLIST

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* GROUND EFFECT MACHINES

Ground Effect Machines (GEM) which ride on a cushion of air are being considered by the Navy for possible future missions in antisubmarine warfare, as troop and equipment carriers with assault task forces, as cargo carriers for logistical missions and perhaps as aircraft carriers or missile launchers.

The Navy, in an official periodical this week, lists three main shortcomings in present GEM development:

✓ Creation of spray in over-water operation at low-speed.
✓ Control problems at low speeds and during hovering.
✓ Control problems in high speed turns.

One Naval spokesman also warns against the temptation to build an all-purpose GEM. The Navy is said to have learned from experience that specific aircraft and ships are best when designed for specific missions. However, designing specific capabilities into one vehicle also raises problems of design and application. For example, a GEM for assault use might ideally be designed flat to permit onboard stacking in tiers. However, this raises the question of a cockpit for operator visibility, or power plant, or exterior controls that might protrude from the top or sides. One firm has suggested on inflatable GEM to solve such a problem, others believe these items might be retractable.

GEM TESTBEDS

The Navy Bureau of Ships intends to obtain data from four different test vehicles being built by contractors this year. From these testbeds, and from additional research, enough "know-how" may be gained to build a 50-foot test craft next year, and a 150-foot ocean-going craft for experiments and evaluation in ASW and amphibious work in 1963. Test Vehicles on order include:

✓ Modified Waterwall Principle -- This is the Hughes Tool Company XHS-1 Hydrostreak delivered in May. It has two skegs, one on either side of hull and a waterwall at each end to trap the cushion of air formed by a fan in the center.

✓ Complete Waterwall -- This is a second test craft to be delivered soon by Hughes Tool Company and will consist of a complete waterwall with "no feet in the water" with the exception of scoops and a propeller. (Both this craft and the XHS-1 will be limited to a water environment by their design characteristics.)

✓ Sidewall Vehicle -- This vehicle, under construction by Bell Aircraft, will have airwalls fore and aft and is scheduled for delivery this month.

✓ Peripheral Jet -- This craft, incorporating a completely peripheral jet operation is being built for the Marine Corps by National Research Associates of College Park, Md. and is expected to be capable of land or water operation.

* PROJECT RAM

Project Ram (Research, Aviation Medicine) is concerned with the application of telemetry as a tool in both basic and applied research on aviation medicine. Objective is "to develop adequate and suitable pickups, to detect the desired physiological responses to be transmitted, and to perform tasks as desired to evaluate the stamina of men and animals in flying aircraft and missiles."

Flying laboratory for the project is an R5D - DC4 aircraft. Currently under development are a telemetry oxygen meter and a transducer for recording blood pressure. Both may, in the future, utilize a nuclear power source. Being contemplated is a study of simulated instrument flying which would involve a special pair of glasses for aviators in flight to simulate actual instrument conditions.

(Staff and equipment of Project RAM is available to other laboratories and installations. Problems concerning instrumentation are "especially welcome". Contact: LCDR Victor A. Praether, MC, USN, Naval Medical Research Institute, National Naval Medical Center, Bethesda, Md.)

* ARDC TECHNICAL OBJECTIVES

Air Research and Development Command has issued a reminder that it is releasing to science and industry a series of 26 "technical objectives" in such areas as propulsion, mechanics of flight, electronic techniques, communications, advanced weapons etc., both within and beyond the earth's atmosphere.

Any qualified organization in science and industry that is a research and development contractor, or has the capability of becoming a contractor is eligible. Most of the documents are classified, requiring security measures.

(Organizations interested in participating in this program should write to Air Research and Development Command, Andrews Air Force Base, Washington 25, D. C. ATT: RDR-121)

* PLASTIC WINDOW PANES

The Navy reports a number of advantages from the use of translucent plastic windows to replace broken wire-reinforced glass panes and plain glass panes at the Pear Harbor Naval shipyard industrial buildings.

The plastic sheet is produced by saturating a set amount of very fine woven glass fiber filament uniformly in polyester resin. This sheet is then cured under hydraulic pressure and high temperature to attain uniform thickness, strength and durability.

Advantages claimed include: no replacement costs since plastic panes are not susceptible to damage; cheaper material costs (81 cents vs. $1.10 per square foot); lower labor costs -- by some 80 percent; and better light, "a soft diffused light in contrast to the hot and glaring light obtained through glass panes."

(Reported to Bureau of Ships, U. S. Navy by A.K.W. Yuen, Maintenance Control Division, Pearl Harbor Naval Shipyard, Hawaii)

* WAGTAIL MISSILE

The "Wagtail" missile being developed by Minneapolis-Honeywell is designed for greater penetration effect through low-altitude launch, according to the Air Force. The air-to-ground weapon will use forward-firing rockets after launch and before ignition of the primary power plant. It is reported that this will permit very low velocities while the guidance system adjusts to the target. The weapon will then be capable of "climbing" over obstacles such as hills and trees, and attack at a low level.

* CBR WARFARE

Subcommittee on Disarmament, Committee on Foreign Relations, U. S. Senate, has prepared a new study of Chemical-Biological-Radiological warfare and its disarmament aspects.

Spending for this phase of national defense, particularly in research and development, is steadily rising. For Fiscal year 1960, the Chemical Corps requested $139.2 million and actually received $103.4. In Fiscal 1961 the Chemical Corps proposed $134.5 and the President recommended $133.8.

About 75 percent of the current budget is for research, development, test and evaluation and procurement of equipment and missiles. About 50 percent of Chemical Corps funds are spent under contract with private institutions and firms.

Here is the Subcommittee's summary of important military characteristics of CBR agents:

✓ Range of effectiveness is so great that the commander may choose a weapon for almost any degree of effect desired--from temporary, harmless incapacitation of a small unit to a massive lethal attack against a large concentration. This selectivity makes it possible for operations to be undertaken against enemy troops occupying territory of a friendly people. The use of nuclear or high-explosive weapons would be destructive to friend and foe alike but if some agent such as the psychochemicals were available, the enemy might be overcome with a minimum of distress to the friendly population.

✓ CBR weapons are used mainly against personnel. Other than flames and incendiaries, CBR agents are not destructive to facilities. Thus, they offer the possibility of effective military action without the destruction of industrial plants, homes, transportation facilities, and cultural buildings. The lack of destructiveness of CBR agents to facilities makes them of little or no use in certain tactical situations where it is desired to destroy or disable bridges, tanks, or guns.

✓ Means of dissemination are many. Existing delivery systems for other weapons may be used, such as artillery, missiles, submarines, and aircraft. Or some new means might be devised like the Japanese incendiary balloons which were sent to burn U. S. forests in World War II. These balloons could easily be adapted to strew biological weapons over a broad area. Floating mines, devised to be carried long distances by ocean currents and to release their contents along shores where prevailing winds would spread germs inland, could be difficult to defend against. CB agents would be especially effective in clandestine operations against sources of water and food or in ventilation systems of large buildings. This kind of sabotage could be effective in connection with surprise attacks with nuclear weapons, provided precautions were taken to prevent "tipping off" the attack.

✓ CBR weapons are pervasive; they can seep into foxholes and underground installations, and reach troops who might be well protected against high explosives or even the immediate effects of nuclear explosions. The characteristic of pervasiveness, however, would offer no special advantages over other weapons in fast-moving tactical situations where troops have not dug in deeply. In fact, where persistent toxic gases have been used to interdict the use of certain areas in fluid situations, any advantage to the user of the gas might be reduced if a turn of events likewise inhibited his own use of the areas which he had gassed.

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✓ Chemical and biological weapons are relatively cheap and easy to produce. The raw materials are usually easy to acquire and do not need the immense industrial facilities for processing that are required for ships, aircraft, and missiles. This places these weapons within the capabilities of almost any small country. However, if effective dissemination should call for expensive delivery systems, this would rule out the use of CBR weapons by countries which could not afford these costly tools. (In respect to delivery systems, this is a field in which much research and development remains to be done since most of these systems are carryovers from the two World Wars and the improvements which were available in 1941-45 were not battle tested.)

✓ CBR weapons are more sensitive to meteorological conditions than other weapons, a limiting factor affecting their use.

* CBR WEAPONS

Here is a summary of major CBR weapons:

ø Toxic Agents includes gases which produce casualty effects when inhaled, ingested or when they come in contact with the skin. There are four general types: choking gases, nerve gases, blood gases, and blister gases. A fifth type, incapacitants, is presently at the development and testing stage.

✓ Choking gases produce casualties by their action on the nose, throat and lungs. A seepage of fluid from affected membranes fills the lungs and cuts off the supply of oxygen. An April 15, 1915 attack was made with chlorine, a choking gas which was effective because the Allied troops were unprotected. As soon as crude gas masks were supplied, a mixture of phosgene and chlorine was used; phosgene is more deadly than chlorine but not sufficiently volatile to be used alone in cloud attacks so it was mixed with chlorine. The phosgene penetrated the early masks and produced a high rate of casualties. Diphosgene was also used by the Germans and the physiological effect was the same as for phosgene. Both gases, like chlorine, are nonpersistent. Another choking gas, chloropicrin, was used in the First World War with other gases because it often penetrated ordinary masks, causing the men to remove them and become victims to the more toxic gases. Chloropicrin is less toxic than phosgene but highly irritant.

✓ Nerve gases. These systemic poisons, developed and stockpiled (but never used) by the Germans in World War II, are the most lethal of the gases which have been standardized. There are three compounds: tabun, sarin, and soman, all having the same physiological action in that they affect the parasympathetic nervous system. The Soviets captured a tabun-producing plant and a large stockpile of this gas during the last phase of the war in Germany. The United States has adopted sarin (symbol GB) which is more toxic than tabun. All three are quick-acting casualty gases which are effective either through inhalation or contact with the skin. They are relatively cheap to make and easy to store. As to toxic effect, the former Chief Chemical Officer of the U. S. Army, Maj. Gen. William M. Creasy (USA, ret.), told a House committee that it would take 75 tons of mustard gas to equal 1 ton of nerve gas in casualty effect.

✓ Blood gases. Three types have been developed: hydrogen cyanide (AC), cyanogen chloride (CK), and arsine (SA). The first two gases are quick acting and interferes with the utilization of oxygen by body tissues. Arsine not only interfere with the functioning of blood but damages the liver and kidneys and is a delayed-action agent.

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✓ Blister gases. These are the arsenical and mustard gases. Mustard gastic (bis(2-chloroethyl) sulfide) was the most effective gas used during World War I and produced more casualties than any other gas. It is a persistent agent and, therefore, effective in harassing and interdiction actions. Besides the World War I type of mustard gas (H), there are distilled mustard (HD) and two kinds of nitrogen mustards (HN-1 and HN-3); a third (HN-2) is too unstable for efficient military use.

The arsenical blister agent is lewisite (L) which was developed just too late for combat use in World War I. It is persistent (but less so than mustard) and acts more rapidly than the mustard group.

ø Smokes. These agents are used for screening or for signaling; they were developed and used in World War I and also extensively used by both sides in the last World War. They are not lethal under most conditions but exposure to very heavy smoke concentrations for a short time or to lighter concentrations over prolonged periods can be injurious and the burns from the burning particles in white phosphorus smoke (WP) are painful and slow healing.

The most common screening smoke agents are titanium tetrachloride (FM), sulfur trioxide-chlorosulfonic acid solutions (FS), hexachloroethane mixture (HC), white phosphorus (WP), plasticized white phosphorus (PWP), and oil smoke which is produced from petroleum by physical means.

ø Incendiary agents. These include fuels for flamethrowers, flame mines, fire bombs, and incendiary grenades.

Fuels for flamethrowers and fire bombs consist of gasoline thickened with napalm, aluminum soap, or other substances which, stirred into gasoline, cause the mass to become a homogeneous gel. This gives the fuel a slower burning rate and causes it to cling to surfaces; also it increases the range of flamethrowers. White phosphorus is added as an igniter.

For destroying equipment and materiel, thermite and thermate bombs and grenades are used. Thermite is a mixture of 73 percent powdered iron oxide and 27 percent fine granular aluminum which produces temperatures of around 2,200° C. Thermate mixture includes thermite plus additives. Magnesium dust, gasoline, and asphalt are also used to make incendiary bombs.

ø Training and riot control agents. Chlorine is commonly used in gas chambers for training troops in use of defensive equipment and in gas discipline.

Tear and vomiting gases are used for riot control and were used extensively during the First World War as harassing agents. Tear gas is chloroacetophenone and vomiting gas is a mixture of tear gas and adamsite. These are not casualty-producing gases under field conditions and have little military purpose except their nuisance value.

ø Incapacitants. The spectrum of chemical warfare possibilities appears to be on the verge of very significant enlargement due to the experiments which are in progress with incapacitants. These are of two types, one rendering a person physically incapable and the other making him mentally incapable of functioning normally for a period of time, after which he recovers without ill effects. While the project is highly classified, it has been divulged that one compound being tested is a derivative of lysergic acid, known as LSD 25. One group of incapacitants causes temporary paralysis, blindness, or deafness while another produces hallucinations and other mental aberrations which affect an individual's judgment and decision-making abilities. Both groups are nonlethal in the sense that the ratio between incapacitating and lethal doses is very large--perhaps of the order of 1,000 to 1.

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✓ STEEL: Development of new steels and alloys with special properties required in missile construction and atomic energy is a major research goal, with the emphasis on an investigation of the factors which control uniformity in the quality of metal produced.

Further studies are already underway on vacuum melting, which will serve to remove gases and other harmful volatile contaminants present in steel. Research is continuing on the addition of depleted uranium to alloy steel in order to improve its tensile strength and other physical properties.

Efforts to reduce steelmaking costs include experiments in the direct production of steel from iron ore, as well as the conversion of pig iron to steel in the blast-furnace "runner."

The Bureau also intends to continue development of new tests for determining the hot-working properties of wrought steel, which will improve the quality of the product by making possible rapid detection of any metal which does not meet required specifications. Another approach involves experiments with a scrap preheater. Tests with an electric furnace and an oxygen converter will permit greater utilization of scrap in this steelmaking process. Tests will also be run to evaluate the possibility of using carbonaceous fuels in an oxygen converter.

The Bureau's experimental blast furnace will continue research on injecting natural gas and fuel oil as a partial substitute for coke in the production of pig iron. Studies will be made on the use of lime and dolomite agglomerates and pre-mixed burdens as blast-furnace charge materials. Bureau metallurgists will conduct further studies on the effect of adding moisture to the blast, enriching it with oxygen and increasing hot blast temperatures. Fundamental research will include a determination of the high-temperature physical constants which are essential to an understanding of high-temperature metallurgical reactions. The activity coefficients of such important alloying elements as chromium and nickel will also be studied.

✓ CHROMIUM: Principal aim for this year's studies is the recovery of chromium from low-grade domestic minerals. Researchers are seeking an economic flotation method for producing usable chromite concentrate from materials that are below the present ore cutoff grade. Other research is underway to improve the efficiency of pyrometallurgical techniques for recovering chromium, and methods for producing chromium or ferrochromium from subgrade chromite-bearing materials.

✓ NONREFRACTORY CLAY: Exploration and evaluation of clays and shales suitable for lightweight aggregate will be continued during the year. In the laboratory, Bureau researchers are making fine-grinding tests on certain kaolins, and will attempt to develop a special machine for continuous ultrafine grinding of kaolin and similar soft materials.

✓ PHOSPHATE: Research and development on planer mining methods and recovery techniques, and the feasibility of using a statistical approach in estimating phosphate reserves are major projects. A redesigned phosphate-rock planer will be field-tested in cooperation with producing companies. Bureau researchers will study beneficiation methods aimed at upgrading phosphate rock of the Western field. Product development and improved disposal are also to be investigated. The statistical analysis will be in cooperation with a producing company. If analysis of sample data proves feasible the Bureau plans to develop guides for sampling and exploration programs.

✓ BAUXITE, ALUMINA AND ALUMINUM: Development and use of low-grade domestic sources of alumina for producing aluminum will be a major objective, with a number of potential processes undergoing studies. Using laboratory-type reduction cells, research will also examine the variables controlling the electrolytic deposition of aluminum, with a view to improving operating efficiency. They will, in addition, apply mineral beneficiation techniques to remove carbon from aluminum plant bath skimmings and flue dust so that alumina and other materials recovered can be returned to the reduction cell.

Laboratory studies will be started on the electrolytic reduction of aluminum chloride in fused-salt baths and nonaqueous electrolytes. Experiments will be undertaken on electrorefining aluminum from crude aluminum-silicon alloys produced from domestic aluminum silicates, and the use of molten zinc for extracting aluminum from such crude alloys. Other research will involve the preparation and determination of the physical properties of hypereutectic alloys of aluminum and silicon.

✓ REFRACTORIES: "Super" refractories for space vehicles and metallurgical and chemical processes are a major goal. An all-inclusive program on the refractory properties of pure oxides will range from a study of the decomposition of certain salts to form pure oxides to a study of the special properties of the oxides and their possible application. Special equipment will be developed for growing single crystals of pure oxides and for studying reactions of materials in the solid state.

Research will continue on the fabrication and testing of lightweight basic refractories with particular reference to their use in the roofs of open-hearth steel furnaces. A new program will be started to develop a continuous melting procedure for synthetic nonmetallic minerals. Among the factors to be investigated are: Effect of particle size of raw materials, relationship of feed rate to power demand, electrode consumption and the effect of continuous operation on composition and physical properties of materials.

Research will also include a study of new methods of forming ceramic shapes at high temperatures. Methods to be investigated include reforming of shapes by rolling at high temperatures and pressures, and consolidation of raw materials by heat and pressure. The possibility of volatizing and condensing ceramic materials under controlled temperature and pressure will also be examined.

✓ MICA: Research in this field will emphasize development of materials to substitute satisfactorily for strategic block and film mica. The Bureau will seek ways to grow large crystals of synthetic mica and will study conditions governing the growth of mica crystals, the synthesis and properties of many compositions of synthetic mica, and possible methods of converting synthetic mica flakes to sheet material suitable for electronic uses. The Bureau will also test the feasibility of producing synthetic mica from impure, but abundant, raw materials.

✓ OTHER: The Bureau's rhenium program will include investigations of new sources and techniques for direct separation from molybdenite by leaching. Gallium studies will be directed toward accurately determining density data from 30° to 400° C for use in other basic research on pressure-volume-temperature measurements of natural gas and petroleum compounds. Indium will be one of several metals used in developing improved magnesium-based alloys. Extraction and separation of cesium and rubidium will be studied, as will commercial recovery of scandium from uranium plant solutions.

PUBLICATION CHECKLIST

- COLUMBIUM, an evaluation by the Defense Metals Information Center of the physical and mechanical properties of columbium and seven columbium alloys for use in atomic reactors and space vehicles. Published February 1960 and now available. 66 Pages. $1.75. (Write OTS, U. S. Department of Commerce for PB 151 082)

- SALINE WATER CONVERSION, three new technical reports are available.

  "Development of Solvent Demineralization", describes experimental work by the Texas A&M Research Foundation. $2.25. (PB 161 769)

  "Membranes...for Selective Electrodialysis", contains the results of studies by the Polytechnic Institute of Brooklyn. $2. (PB 161 694)

  "Zone Purification Process", a study by Battelle Memorial Institute revealing that this process is not competitive with other zone-freezing systems now under development. $1. (PB 161 766)

  Order by number from OTS, U. S. Department of Commerce, Washington 25, D. C.

- DYNAMIC PRESSURE TRANSDUCERS, a survey by the Army's Diamond Ordnance Fuze Laboratories (as of Sept. 1959) of commercially available dynamic pressure transducers. Users of these devices should find the information useful for selecting one which will best serve for a particular measurement. 18 Pages. Microfilm, $2.40. Photocopy, $3.30. (Order DOFL Tech Rept. TR814 from Photoduplication Service, Library of Congress, Washington 25, D. C.)

- NASA CONTRACTS, a listing of contracts, totalling more than $134 million, awarded by the National Aeronautics and Space Administration and its various Research Centers during the Period January 1, 1960 through June 30, 1960. 22 Pages. Single Copies Free while available. (Write Information Office, NASA, 1520 H Street, N. W., Washington 25, D. C. for Release No. 60-253)

- CBR WARFARE, an informative and thought-provoking review by a Congressional Subcommittee staff. Includes a selected bibliography. 43 Pages. Single Copies Free. (Write Committee on Foreign Relations, Subcommittee on Disarmament, U. S. Senate, Washington, D. C. for CBR Warfare and Its Disarmament Aspects)

- IMPACT OF IMPORTS, statements, testimony and exhibits presented to a Congressional subcommittee on the pros and cons of imports as affecting small business. Includes a discussion of a number of import problems, including electronics. 315 Pages. Single Copies Free. (Write Select Committee on Small Business, U. S. Senate, Washington, D. C. for Hearing--the Impact of Imports on American Small Business)

- STANDARDIZATION ACTIVITIES IN THE U. S., a descriptive inventory of the work and objectives of organizations involved in standardization activities. A comprehensive index covers such product areas as textiles, paper, leather, ceramics, plastics, electrical equipment, rubber, cement, and lists appropriate organizations. 210 Pages. $1.75. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for NBS Miscellaneous Publication No. 230)